

CONCLUSION

Coastal erosion is a natural and continual process with impacts registered on the time scale from annual to geological. The Big Sur coast is a dramatic meeting of land and sea with many sheer cliffs and active natural erosion sites. Since first opening in 1933, Highway One has been subject to closure due to erosion and landslides. Erosion sediment from natural and anthropogenic landslides and highway maintenance activity may be detrimental to the habitats of coastal streams, the Monterey Bay National Marine Sanctuary, and may also impact animals and plants of terrestrial habitats, all three habitats contain endangered species. This study was not intended to, nor did it document biological impacts to endangered species or sensitive habitats.

The primary conclusion of this report is that re-vegetation and erosion control work conducted on Highway One may offset and mitigate highway related erosion impacts but cannot be expected to deal with natural erosion nor will it prevent geologic scale events.

The second conclusion is that site specific native plant material can be successfully collected and utilized for the re-establishment of plant cover that may be beneficial for habitat recreation and surface erosion control.

Discussion

The vegetative restoration of erosion sites is based upon recreating the composition, density, and cover of plants that existed prior to the erosion event. In addition, for greater stability, the slope and aspect of a restoration site should be realigned with adjacent contours. Baseline analyses of pre-existing or adjacent vegetation can provide the targeted plant species palette, numbers of plants, and the density at which the plant materials is to be re-established. Successful restoration of erosion sites shall be determined when the recreated vegetation types (plant communities) resemble those existing prior to the event. In some cases, restoration may take many years. Short-term erosion control can be effectively used to stabilize a site and control surface erosion.

Vegetation is not constant. A given plant community type can be classified, but in 10, 50 or 100 years, vegetation on a site can change dramatically in character. Early models of plant community organization

stressed the concept of succession. That is, the initial stands of a restored area will be composed of wind-tolerant, dry-tolerant, pioneer species, which in turn will eventually provide shade and protection so that the terminal stands will contain "climax" species. However, that model has not worked in many places in North America and certainly does not apply to all places in central coastal California. Indeed, current research supports more complex models, which represent a given area at a specific time as a "patch" in a dynamic landscape. Replication of original vegetation will take time. Changes to the local site, along with changes in climate (both long-term changes like global warming and short-term events like El Nino) will influence what species thrive on a given site during a given cycle of restoration. Exotic pest plants can also greatly effect plant community structure at a restoration site.

Species which colonize a given land patch will inevitably be those which can tolerate the soil, microclimate and water regime present at an erosion site. Erosive soils present after a landslide event will probably support a plant community that is different from the pre-event plant community. There are clearly restraints on the species that colonize disturbed patches. Natural regeneration will proceed, albeit very slowly, from species which disperse onto the site via wind, water or other community members (birds, small mammals, etc.). Seed banks in soils can harbor persistent species for decades. A local source of seeds is required for natural regeneration. By collecting native plant material from many species on similar adjacent sites, then planting them with modern establishment techniques, re-establishment of a natural community will occur at a much faster rate than if erosion areas were simply abandoned. The Coast Highway corridor is heavily infested by exotic and invasive weed plant species. These weed species aggressively out-compete native plants and are highly adapted to colonize disturbance sites such as landslides. These weeds can invade a site and preclude the successful native plant restoration on the site. Therefore it is very important to re-vegetate a slide site with native plant material as soon as possible, and to maintain the site to prevent establishment of weed species.

Critique of site ranking system

The sites were evaluated and ranked before the rainy season. The ranking did allow some sites to rank high for potential problems and yet they did not experience problems during the following wet season. The predictive value of the ranking system is questionable at the present, and with more site data collection and greater experience, the accuracy should improve.

Conclusion

Future Research Needs and Recommendations

1. How to select sites for erosion control and vegetative restoration

Are sites selected where long-term restoration can have significant impact with proactive value to prevent further erosion and large - unstable sites treated superficially?

2. Dry water crystals containment

This material appears to have value in establishing vegetation in dry and/or hard to irrigate areas. How should it be installed to prevent littering of the landscape with non-biodegradable containers?

3. Timing of exotics control

Each species of exotic plant infesting the Highway One environment on the Big Sur coast has an optimum time for its chemical and physical control. The control program should be developed to determine and implement the optimum control period.

4. Mineral soil treatments

The mineral soils of the coast have nutrient limitations and may lack the soil constituents that are important for success of the restoration plant community. A protocol for soil analysis should be developed to provide the necessary soil amendment information for the planting program. The program should provide focused fertilization to prevent weed growth and may use legumes to improve soil nutrients. Further evaluation of the use of mycorrhizae should occur.

5. Safety for site work

Who should determine when it is unsafe to work on a site? Establish a site safety protocol for restoration work on the Coast Highway. This should include an alert to CalTrans when workers are to be on a site and evaluate the site safety from the perspective of the restoration worker and to the public.

6. Long-term site maintenance

Restoration of the plant community and soil stabilization of a site may take many years. The following questions need answers:

- How to fund long-term work
- Who would do the work
- Who would monitor site
- Who will determine restoration goals have been attained